REPORT DOCUMENTATION PAGE

Form Approved OMB NO. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
17-05-2014	Final Report	1-Oct-2009 - 30-Sep-2013

4. TITLE AND SUBTITLE
Game-Theoretic Models of Conflict and Social Interactions

5a. CONTRACT NUMBER
W911NF-09-1-0556

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
611102

6. AUTHORS
Daron Acemoglu, Asuman Ozdaglar

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES
Massachusetts Institute of Technology (MIT
77 Massachusetts Ave.
NE18-901
Cambridge, MA 02139 -4307

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS (ES)
U.S. Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSOR/MONITOR'S ACRONYM(S)
ARO

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
56549-NS.8

12. DISTRIBUTION AVAILIBILITY STATEMENT
Approved for Public Release; Distribution Unlimited

13. SUPPLEMENTARY NOTES
The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT
The goal of this research effort is to develop a systematic framework for the study of political conflict, the belief systems
underlying such disagreements, and potential ways of avoiding conflict. Our focus has been on developing quantitative models of
social conflict and individual behavior, and developing new theoretical tools to study the dynamics of belief formation and

15. SUBJECT TERMS
Conflicts, beliefs and social interactions

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Asuman Ozdaglar
UU	UU	UU	UU		19b. TELEPHONE NUMBER 617-324-0058

Report Title

Game-Theoretic Models of Conflict and Social Interactions

ABSTRACT

The goal of this research effort is to develop a systematic framework for the study of political conflict, the belief systems underlying such disagreements, and potential ways of avoiding conflict. Our focus has been on developing quantitative models of social conflict and individual behavior, and developing new theoretical tools to study the dynamics of belief formation and evolution in models of political conflict and compromise. Our objective has been to provide qualitative analysis that give insights into the sources of political and social conflict and quantitative or computational methods for decision makers that can provide tools for derivation of new policies.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received		Paper
05/17/2014	7.00	Daron Acemoglu, Asuman Ozdaglar. Opinion Dynamics and Learning in Social Networks, Dynamic Games and Applications, (10 2010): 0. doi: 10.1007/s13235-010-0004-1
08/31/2011	1.00	Daron Acemoglu, Asuman Ozdaglar, Ali ParandehGheibi. Spread of (mis)information in social networks?, Games and Economic Behavior, (11 2010): 0. doi: 10.1016/j.geb.2010.01.005
11/07/2011	2.00	D. Acemoglu, G. Egorov, K. Sonin. Political Selection and Persistence of Bad Governments, The Quarterly Journal of Economics, (11 2010): 0. doi: 10.1162/qjec.2010.125.4.1511
11/07/2011	3.00	Daron Acemoglu, Davide Ticchi, Andrea Vindigni. EMERGENCE AND PERSISTENCE OF INEFFICIENT STATES, Journal of the European Economic Association, (04 2011): 0. doi: 10.1111/j.1542-4774.2010.01008.x
TOTAL:		**4**

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received		Paper
TOTAL:		

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received		Paper
12/05/2012	4.00	Daron Acemoglu, Giacomo Como, Fabio Fagnani, Asuman Ozdaglar. Opinion Fluctuations and Disagreement in Social Networks, Mathematics of Operations Research (01 2011)
12/05/2012	5.00	Ercan Yildiz, Daron Acemoglu, Asuman Ozdaglar, Amin Saberi, Anna Scaglione. Discrete Opinion Dynamics with Stubborn Agents, ACM Transactions on Economics and Computation (11 2011)
12/05/2012	6.00	Daron Acemoglu , Georgy Egorov , Konstantin Sonin. A POLITICAL THEORY OF POPULISM, Quarterly Journal of Economics (12 2011)
TOTAL:		**3**

Number of Manuscripts:

Books

Received	Paper

TOTAL:

Patents Submitted

Patents Awarded

Awards

- D. Acemoglu delivered the Hicks lecture at the Society for the Advancement of Economic Theory in 2011, the Laffont lecture at the European meetings of the Econometric Society in 2011, and keynote addresses at the WINE conference, the Public Economic Theory Conference, and the State of the Art lecture at the Canadian Economic Association Conference.
- D. Acemoglu was appointed editor-in-chief of Econometrica in 2011.
- D. Acemoglu was elected to the National Academy of Sciences in 2014.
- D. Acemoglu received presidential grant award for culture and art in Turkey.
- A. Ozdaglar received Steven and Renee Finn Innovation Fellowship in 2013.
- A. Ozdaglar was elected a Kavli fellow of the National Academy of Sciences in 2011.
- A. Ozdaglar was elected to serve as an associate editor for IEEE Transaction on Automatic Control in 2011 and area editor in Operations Research in 2013.
- A. Ozdaglar gave a keynote speech in the Coordinate Science Lab Student conference, UIUC in 2010, a semi-plenary talk in the International School and Conference on Network Science in 2010, a plenary talk in Optimization Days Conference in 2011 and a plenary talk in INFORMS Revenue Management Conference in 2011.

Graduate Students

NAME	PERCENT_SUPPORTED	Discipline
Kimon Drakopoulos	0.25	
FTE Equivalent:	**0.25**	
Total Number:	**1**	

Names of Post Doctorates

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Names of Faculty Supported

NAME	PERCENT_SUPPORTED	National Academy Member
Daron Acemoglu	0.33	Yes
Asu Ozdaglar	0.33	
FTE Equivalent:	**0.66**	
Total Number:	**2**	

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:..... 0.00

Names of Personnel receiving masters degrees

NAME
Total Number:

Names of personnel receiving PHDs

NAME
Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

Under the auspices of this project, we developed a model for the analysis of spread of misinformation in societies. Our analysis is motivated by the widespread differences in beliefs across societies and more explicitly, the presence of many societies in which beliefs that appear to contradict the truth can be widely held. Our main results quantify the extent of misinformation in the society by either providing bounds or exact results (in some special cases) on how far the consensus value can be from the benchmark without forceful agents (where there is efficient information aggregation). These bounds highlight the impact of key network properties on the extent of misinformation in societies. This was a first attempt at quantifying the extent of misinformation in opinion formation. This work is now published as Spread of (Mis)Information in Social Networks, Games and Economic Behavior, November 2010, 70(2), pp. 194-227.

- Continuing with this theme, we extend this work in important directions. In particular, our past work assumed that “no man is an island”, implying that even forceful agents and those potentially with adversarial objectives update their opinion. This ensured that opinion dynamics converge to a consensus (agreement) tough this value is influenced by the forceful agent opinions. Both this assumption and the implied agreement in opinions are not empirically attractive as agreement in the society is the exception, disagreement is the norm, and both forceful agents and adversaries often will push a particular point of view relentlessly. In our new work, we incorporate this feature by including in the social network stubborn agents with fixed opinions. This implies that opinion dynamics will not reach consensus, instead opinions of non-stubborn agents will fluctuate. We show that in this setting, opinions converge in distribution, and characterize both average behavior and fluctuations in this limiting distribution as a function of network structure and location and opinions of stubborn agents. These results are contained in our new paper “Opinion Fluctuations and Disagreement in Social Networks”.

- A model with stubborn agents also enables us to model adversarial situations in which a subset of adversaries try to mislead a population. This interpretation immediately suggests a control perspective, whereby the network structure can be modified in order to limit the influence of adversarial opinions. In other recent work, we showed that this is a computationally hard problem and developed efficient approximation algorithms with performance guarantees for its solution. The results of this work are contained in “Discrete Opinion Dynamics and Control with Stubborn Agents”. In other related work we used this model for the study of informational strategies of counter-insurgency in Afghanistan. We have used our algorithm to identify the most effective means for influencing society to draw the opinions to a desirable state. We have published these results in a conference paper “Optimization-Based Influencing of Opinion-Leader Social Networks in a Counterinsurgency.”

- In another paper “Political Selection and Persistence of Bad Governments,” forthcoming in Quarterly Journal of Economics, we investigate dynamic interactions between different individuals and social groups wishing to dominate government. We show how dynamic interactions resulting from concerns about future changes in government compositions can lead to the emergence and persistence of unboundedly inefficient governments.

Technology Transfer